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Operating Instructions

SENSITIVE
VALVE VOLTMETER

Type TF 1100

MARCONI INSTRUMENTS LIMITED, ENGLAND

340

OPERATING INSTRUCTIONS No. EB 1100

for

SENSITIVE VALVE VOLTMETER

TYPE TF 1100

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	DRAWINGS	Ref
	CIRCUIT DIAGRAM (2 sheets)	TC25435
	BLOCK SCHEMATIC DIAGRAM	XD25315

DATA SUMMARY

SENSITIVE VALVE VOLTMETER TYPE TF 1100

Serial No JA46/001 & above

VOLTAGE RANGE:	0 to 300 volts a.c. in 12 ranges with full-scale deflections of 1, 3, 10, 30, 100, and 300 mV, and 1, 3, 10, 30, 100, and 300 volts. The instrument is also calibrated in decibels relative to 1 mW in 600 ohms.
FREQUENCY RANGE:	10 c/s to 10 Mc/s.
MEASUREMENT ACCURACY:	±5% of full-scale from 10 c/s to at least 5 Mc/s.
INPUT RESISTANCE:	10 MΩ on all ranges.
INPUT CAPACITANCE:	15 μμF on the 1- to 300-volt ranges. 25 μμF on the 1- to 300-mV ranges.
AMPLIFIER OUTPUT:	3 volts maximum.
AMPLIFIER VOLTAGE GAIN:	Of the order of 400.
POWER SUPPLY:	200 to 250 volts, or 100 to 150 volts after adjusting internal link, 40 to 60 c/s; 65 watts. Models supplied ready for immediate 100- to 150-volt use if specified at time of ordering. Fuses in both mains and h.t. circuits.

DIMENSIONS:

Height	Width	Depth
12 1/4 in (31 cm)	8½ in (22 cm)	8 3/4 in (22.5 cm)

WEIGHT: 12 lb (5.5 kg).

SCHEDULE OF PARTS SUPPLIED

1. One Sensitive Valve Voltmeter complete with valves, etc., as under:-

Valves:	One:	6267 (EF86), Pentode.
	Five:	E180F, High-Slope Pentodes.
	One:	6X4 (U78), Full-Wave Rectifier.
	One:	6L6G (KT66), Beam Tetrode.
	One:	6AK5 (EF95), Pentode.
	One:	5651, Voltage Stabilizer.
Semiconductors:		
	Two:	CG4E (CV 448), Germanium Diodes.
Lamp:	One:	6.3-volt, 0.15-amp, M.B.C. Pilot Lamp.
Fuses:	One:	1-amp, cartridge type.
	One:	100-mA, cartridge type.

2. One Coaxial Free Plug, Type 83, for front panel input socket.

3. One Instruction Book No. EB 1100

The following items are optional accessories, supplied only if specially ordered:-

4. Probe Unit, Type TM 5269.

5. Terminal Adaptor, Type TM 5272.

1 DESCRIPTION

1.1 GENERAL

The Marconi TF 1100 Sensitive Valve Voltmeter can be switched to have any one of 12 different full-scale deflection values ranging from 1 mV to 300 volts a.c; the minimum voltage which can be measured is of the order of 100 μV.

An amplifier-rectifier type instrument, it maintains good accuracy with moderately distorted waveforms: it is free from 'turnover' effect with asymmetrical waveforms, and has a large overload capacity.

A cathode-follower input circuit is employed : this, with its characteristically high input impedance, is followed by a four-stage video amplifier grouped into two pairs with feedback applied individually over each pair. The output from the amplifier is applied to a meter via a full-wave rectifier.

The meter, as well as being calibrated in units of voltage, also carries an auxiliary scale which is calibrated in terms of decibels relative to 1 mW in 600 ohms. Expressed in this way, the measurement range of the instrument extends from -72 to +52 dBm.

A further cathode-follower stage, fed from the meter amplifier, provides a 75-ohm output at a pair of front-panel terminals. This facility enables the instrument to be used as a wide-band amplifier having a frequency response comparable with that of the voltmeter.

1.2 OPTIONAL ACCESSORIES

Probe Unit, Type TM 5269, consists of a Type 83 plug connected to a probe by a length of low-loss coaxial cable. This accessory fits the coaxial input socket on the TF1100 and facilitates low-level and/or high-frequency measurements.

Terminal Adaptor, Type TM 5272. When making high-level measurements, unscreened terminals are sometimes preferable to a coaxial input socket. The Terminal Adaptor consists of a Type 83 coaxial plug surmounted by an insulated terminal for use in conjunction with the existing earth connector on the front panel of the TF 1100.

2 OPERATION

2.1 INSTALLATION

Sensitive Valve Voltmeter TF 1100 can be adjusted to allow operation from any 40-c/s to 100-c/s power supply in the voltage ranges 100 to 150 volts and 200 to 250 volts.

Full instructions for adjusting the internal power unit to suit the local supply are given in Section 4.2.

Unless otherwise specified, the TF 1100 is normally despatched ready for immediate operation from 240-volt supplies.

2.2 PRELIMINARIES

Be sure that the instrument is correctly adjusted to suit the particular mains supply to which it is to be connected. Then proceed as follows:-

(1) Check that the mechanical zero of the meter is correctly set.

(2) Make connection to a suitable mains socket by means of the mains lead provided.

(3) Turn the SUPPLY switch ON and note that the pilot lamp glows. The SUPPLY switch is mounted on the rear panel of the instrument.

(4) Before proceeding further, allow a few minutes for the valves to warm up. It will be appreciated that, although the instrument may be used within, say, 5 minutes of switching on, the circuit as a whole takes a longer time than this to reach thermal equilibrium. Test results obtained from a representative number of TF 1100's indicate that during the initial warming-up period sensitivity remains virtually constant with readings being high by some 2%. Approximately 30 minutes after switching on, a slight but progressive decrease in sensitivity commences; after 90 minutes thermal equilibrium is reached and, from then on, measurement errors are at a minimum.

2.3 INPUT CONNECTIONS

The TF 1100 is fitted with a Type 83 coaxial inlet; immediately below this inlet there is a conventional screw terminal. Both the screw terminal and the outer shell of the coaxial inlet - a fixed socket - are connected directly to the chassis of the Valve Voltmeter which is, in turn, earthed via the mains lead.

In general terms, a voltage to be measured can be conveyed to the Valve Voltmeter by means of either (i) a coaxial cable or (ii) a pair of free unscreened leads. In the first case only the Type 83 coaxial socket is used for connection purposes. In the second case - which for convenience requires an input system with two screw terminals - the coaxial socket can be converted to a screw terminal by means of optional adaptor TM 5272 and then used in conjunction with the other terminal immediately below it.

Although convenient for many applications, the use of free unscreened leads and open terminals is not satisfactory when low-level and/or high-frequency signals are to be fed to the Valve Voltmeter for measurement or amplification. If mains hum and other spurious pick-up are not to be introduced with the wanted signal, a screened method of connection must be employed.

Probe Unit TM 5269 is available for use in such circumstances. Two features of its construction are worth noting since they illustrate points of good practice to be observed when making "difficult" measurements with the Valve Voltmeter. The Probe Unit is, basically a low-loss low-capacitance cable; this makes it particularly suitable for high-frequency employment. The second important feature of the probe is that connection to the outer braiding of the cable can be made to a screw terminal which is mounted immediately adjacent to the probe point. This allows the braiding to be "commoned" to the chassis of the equipment under test, in close proximity to the actual point of measurement and with a minimum length of unscreened lead.

Despite observance of the precautions implied above, hum interference may still be encountered in some situations. Consideration should then be given to the earthing, particularly mains earthing, of both the equipment under test and also the Valve Voltmeter. If each has an individual mains earth, then there is the possibility that circulating currents will flow round the loop which is completed by the signal input connections to the Valve Voltmeter. In these circumstances a great improvement in conditions can generally be obtained by ensuring

2.3 (Continued)

that there is only one connection to mains earth when the equipment under test and Valve Voltmeter are considered together as a single system.

CAUTION: When measuring an a.c. voltage superimposed on a d.c. supply, the sum of the d.c. and peak a.c. voltages should not exceed 500 volts.

2.4 USE AS A VALVE VOLTMETER

2.4.1 Voltage Measurement

The TF 1100 is suitable for measuring unbalanced a.c. voltages in the frequency range 10 c/s to 10 Mc/s. Measurements may be made from 100μV up to a maximum of 300 volts in 12 ranges as follows:-

(1) With the left-hand switch (SA) set to the position marked "mV", the settings of the central range switch (SB) correspond to full-scale deflections of:-

1 mV, 3 mV, 10 mV, 30 mV, 100 mV and 300 mV.

(2) With the left-hand switch set to the position marked "V", the range switch settings give:-

1 V, 3 V, 10 V, 30 V, 100 V and 300 V.

Both the meter scale and the range switches have an auxiliary decibel calibration in red. The decibel values are with respect to 1 mW in 600 ohms, i.e., 0 dB corresponds to 0.775 volt. The value of a voltage being measured is related to this datum by taking the algebraic sum of (i) the meter reading on its red decibel scale, and (ii) the decibel markings indicated by the settings of the left-hand V/mV switch and the central range switch.

For example, an input voltage which gives a meter reading of -5 dB when the V/mV switch is set to -60 dB and the central range switch is set to +20 dB is 45 dB down with respect to 0.775 volt since -5 -60 +20 = -45.

2.4.1 (Continued)

Although the relationship to 1 mW is no longer valid, the decibel calibrations on the Valve Voltmeter can, of course, be used when the voltage being measured is developed across an impedance other than 600 ohms. They are of particular value when relative levels in successive measurements are the main concern; for instance, when determining amplifier or filter response characteristics.

The step-by-step procedure for making a voltage measurement is as follows:-

(1) Set the right-hand control (switch SC) to the "V/M" position.

(2) Knowing the approximate voltage to be measured, select either "V" or "mV" using the left-hand control (switch SA).

(3) Turn the central control (range switch SB) fully clockwise to the position marked 300.

(4) Connect the voltage source to the INPUT socket - see Section 2.3.

(5) Using the range switch SB, increase the sensitivity until a suitable meter deflection is obtained .

(6) Having noted the final range setting, the voltage may be read on the appropriate scale of the meter.

2.4.2 Distorted Waveforms

The meter responds to the average value of the voltage under test and is calibrated in terms of r.m.s. value of a sinusoidal input.

From the simple conversion table included below, it will be appreciated that the r.m.s. meter readings are virtually unaffected by moderately distorted waveforms. Even with the extreme examples of square and triangular waveforms, the inaccuracy does not exceed 10%.

	R.M.S. Value	Average Value	Peak Value
Sinusoidal Waveforms	Correct Reading	Reading x 0.9	Reading x 1.414
Square Waveforms	Reading x 0.9	Reading x 0.9	Reading x 0.9
Triangular Waveforms	Reading x 1.04	Reading x 0.9	Reading x 1.8

2.5 USE AS A WIDE-BAND AMPLIFIER

The final cathode-follower stage fed from the meter amplifier, provides a 75-ohm output of up to 3 volts with a frequency response comparable with that of the voltmeter. To use the TF 1100 as a wide-band amplifier:-

(1) Set the right-hand control (switch SC) to the "AMP" position.

(2) Knowing the approximate input level, select either "V" or "mV", using the left-hand control (switch SA).

(3) Connect the OUTPUT terminals to the indicating device or power amplifier, remembering that the output is unbalanced, with one OUTPUT terminal at earth potential.

(4) Connect the signal source to the INPUT socket, as described in Section 2.3.

(5) Use the 6-step attenuator (switch SB) to control the overall gain. Remember, however, that maximum output will be obtained when this control is in the fully anti-clockwise position - the reverse of a normal gain control.

3 TECHNICAL DESCRIPTION

3.1 CIRCUIT DETAILS

It is suggested that the following sections be read in conjunction with the Functional and Circuit Diagrams included at the end of this handbook.

3.1.1 Input Connection

The coaxial input socket fitted to the TF 1100 is a standard Type 83 Connector. (United States, Military No. SO 239; Great Britain, Transradio Ltd., Code No. CD 071.)

Connection to the instrument should be made using the Type 83 free plug supplied (United States, Military No. PL 259A; Great Britain, Transradio Ltd., Code No. GD 071) or , alternatively, by using one of the optional accessories listed under Section 1.2.

3.1.2 Volts/Millivolts Switch

Coarse control of sensitivity is provided by the Volts/Millivolts switch, SA. When set to Volts (V), this introduces a 1000:1 fixed potentiometer into the signal path between the input socket and the grid of the first valve, V1. The main components in the potentiometer are R1, R2 and R3. Frequency correction is applied by means of RC and RL networks.

3.1.3 Main Range Switch

The first valve, V1, is a cathode follower and its cathode load is coupled to a 5-section, 50-dB attenuator. The attenuator is a ladder network fed via a single series resistor, R15. With the main range switch set to 1, the output from V1 is taken direct from its cathode and no attenuation is introduced. For other settings of SB the output is taken from the junctions of the ladder network. To minimize capacitive break-through, the switching is distributed over three wafers on switch SB.

3.1.4 Amplifier

The four-stage amplifier has two negative-feedback pairs in cascade; these pairs are frequency compensated by means of suitable correcting networks in each of the feedback loops.

A full-wave germanium-diode rectifier circuit supplies the meter. To avoid undue "cramping" at the low end of the meter scale (due to the

3.1.4 (Continued)

inherent non-linearity of germanium diodes at low signal levels) the rectifier circuit is connected in series with the second feedback loop. At low signal levels, the reduced forward conductance of the diodes decreases the amount of negative feedback applied over the second amplifier pair; the output signal level is thus increased in a manner which tends to nullify the reduction in rectif ier output. The result is an almost linear meter scale.

It will be appreciated that this intentional feedback reduction at low signal levels renders the instrument unsuitable for use as an amplifier when switched to "V/M". The meter rectifiers are automatically taken out of circuit when the instrument is switched for use as an amplifier.

3.1.5 Power Supply Circuits

The mains transformer which forms part of the built-in power unit has a double-wound primary, the two tapped sections of which can be connected in series or series-parallel to allow operation from a selection of supply voltages in the ranges 100 to 150 volts and 200 to 250 volts; full details of the method of adjusting the power unit to suit different supply voltages, are given in Section 4.2.

The main h.t. supply is derived from a low-impedance series-stabilizer circuit (comprising valves V4 and V5 with the reference potential controlled by the gas-filled stabilizer V6); the input for this circuit is drawn from the centre-tapped h.t. winding on the transformer, via full-wave rectifier V2.

All the valve heaters are biased positive with respect to chassis. This positive potential is derived from the gas-filled stanilizer V6, and, with the exception of the h.t. rectifier and stabilizer valves V2, V4 and V5 which are directly connected, applied via hum-neutralizing potentiometers RV2 and RV3.

The mains supply is switched by means of a double-pole switch SD and the instrument is protected by a 1-ampere cartridge fuse. Further protection is afforded by a 100-milliampere fuse of similar type, connected in series with the h.t. negative line.

The input cathode follower, V1, and the final stages V9 and V10 are supplied direct from the cathode of the stabilizer Valve V4 (H. T. 1.). Valves V7 and V8 receive their h.t. supply from a separate line (H. T. 2.)

3.1.5 (Continued)

having a two-stage resistance/capacitance decoupling circuit comprising R36, R58, C13b and C14b. Similarly, components R37, R59, C13a and C14a provide two-stage decoupling for a third h.t. line (H. T. 3) supplying V3.

The power unit forms a separate sub-assembly and is attached to the inside of the back panel of the instrument: connection between the power unit and the main amplifier chassis is by means of an International Octal plug and socket.

4 MAINTENANCE

4.1 REMOVAL OF CASE - ACCESS TO COMPONENTS

4.1.1 Removing the case

The instrument case is constructed from three basic portions: a front panel, carrying the main chassis and controls; a rear panel, on which is mounted the power unit; and a cover formed from three pieces of aluminium-alloy sheet. Removal of the case involves the following procedure:-

(1) Place the instrument on its face, knobs downwards.

(2) Remove the three 2-BA screws securing the rear panel and lift it clear of the case - complete with the power unit. One of the fixing screws is located centrally above the SUPPLY switch while the other two screws are situated 3 inches from the bottom of the rear panel, $6\frac{1}{2}$ inches apart.

(3) Separate the International Octal plug and socket connecting the power unit to the main chassis.

(4) The rear panel may now be set aside and the sheet-metal covers removed from the groove in the front panel frame.

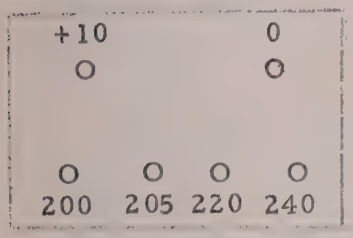
When reassembling the case, particular care should be taken to see that the side and top covers are correctly fitted in their grooves. Also, ensure that the two side covers are not interchanged; the side cover with a ventilation hole (or series of holes) should be fitted on the right-hand side when the instrument is viewed from the front.

4.1.2 Obtaining access to components

The power-supply chassis is mounted on the rear panel and all the components are clearly visible after removing the panel as described in Section 4.1.1.

A screening cover is fitted beneath part of the amplifier chassis, enclosing the components and switches associated with V1, V3 and V7. This cover is secured by seven 6-BA cheese-head bolts. It is, of course, not necessary to remove this cover for valve replacement purposes.

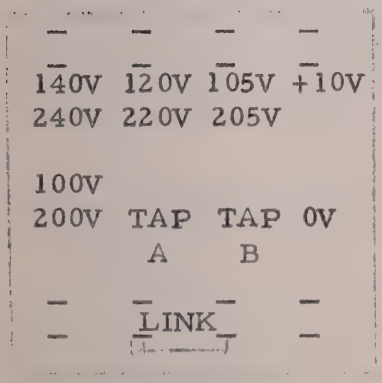
4.2 MAINS INPUT CONNECTIONS



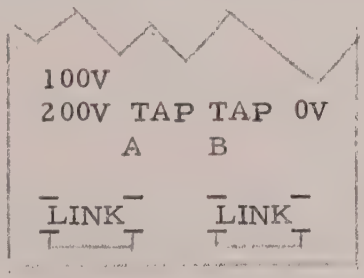
MAINS TAPPING PANEL
(200- to 250-volt range)

To check the mains transformer tapping first inspect the mains tapping panel in the cut-out at the rear of the case. Note that the sum of the voltages at the points to which the leads are connected matches the local supply. If not reposition the leads, one of which must go to either 0 or 10.

To change to the other voltage range, take off the instrument case and reconnect the soldered links on the mains transformer as shown.



TRANSFORMER LINK
for 200- to 250- volt range



TRANSFORMER LINKS
for 100- to 150-volt range

Then return to the tapping panel, remove the retaining screw and reverse the panel to expose the side showing the tapping voltages of the new range. Reconnect the fly leads to the appropriate points.

4.3 REPLACEMENT OF VALVES

All valves are accessible after removing the instrument from its case as described in Section 4.1.

With the instrument removed from its case, and viewed from above, the valves on the main chassis are arranged as follows:-

V1, V3 and V7 are mounted at the left-hand side of the chassis, with V1 nearest to the front panel. On the right-hand side, V10, V9 and V8 are fitted with V10 nearest to the front panel.

Four valves are mounted on the power-unit chassis attached to the rear panel. V2, V4 and V5 are at the right-hand side, viewed from above, with V4 adjacent to the rear panel and V2 nearest to the outside edge of the chassis. V6 is located by itself at the left-hand side of the chassis.

The valves in the TF 1100 may normally be replaced without special selection. It must be appreciated, however, that valves vary considerably with regard to hum and microphony; also, that if the replacement valves are not of the same standard as those originally fitted, and impaired performance may result.

4.4 ADJUSTMENT OF SENSITIVITY

Provision is made for adjusting the overall sensitivity of the TF 1100 when the instrument is completely assembled in its case. It is particularly likely that this adjustment will be required following valve or semiconductor replacement; the procedure is as follows:-

(1) Set the right-hand control (switch SC) to the "V/M" position.

(2) Using the left-hand control (switch SA), set the input attenuator to the "V" position.

(3) Turn the central control (range switch SB) fully counter-clockwise to the 1 V position.

(4) Connect a standard voltage source, delivering 1 volt, to the INPUT socket. The frequency of this source is not critical, but avoid the use of mains frequency - 1 kc/s is quite suitable.

4.4 (Continued)

(5) Adjust the pre-set control RV4 until full-scale deflection is obtained on the TF 1100. RV4 is screwdriver operated and is located about 3 inches to the right of the SUPPLY switch when viewing the instrument from the rear.

4.5 REPLACEMENT OF SEMICONDUCTORS

Two Type CG4E germanium diodes, X1 and X2, are used in the TF 1100. Both diodes are mounted close to V9 at the rear of switch SC, where they form part of the rectifier bridge supplying the meter.

When replacing the diodes, care should be taken that they are not over-heated during the soldering process, and the use of a thermal shunt is recommended. This item is easily made by soldering copper blocks within the jaws of a small alligator clip. In use, the thermal shunt should be clipped over the lead-out wire, between the diode and the hot soldering iron. When fitting the replacement diodes, polarity should be carefully observed.

Replacement of X1 or X2 will, almost certainly, invalidate the calibration accuracy of the instrument. Both diodes should be replaced at the same time, and the new diodes matched to comply with the following specification:-

(1) The forward resistance of both diodes should be matched to better than 10%.

(2) The ratio of forward to reverse resistance should be at least 2,500 to 1 at 20°C, the two diodes matching each other in this respect to better than 10%.

After replacing the diodes, the sensitivity should be readjusted as discussed in Section 4.4. The calibration accuracy can be completely restorted by this means but, with certain diodes, the overall frequency characteristic may have altered by a small amount.

4.6 WORKING VOLTAGES

The voltages listed on the following page were obtained from measurements made on a typical TF 1100; the voltmeter employed had an input impedance of 20 kΩ/volt, and was set to the range shown in brackets after each reading. Component and valve number codings refer to the main Circuit Diagram supplied with this handbook.

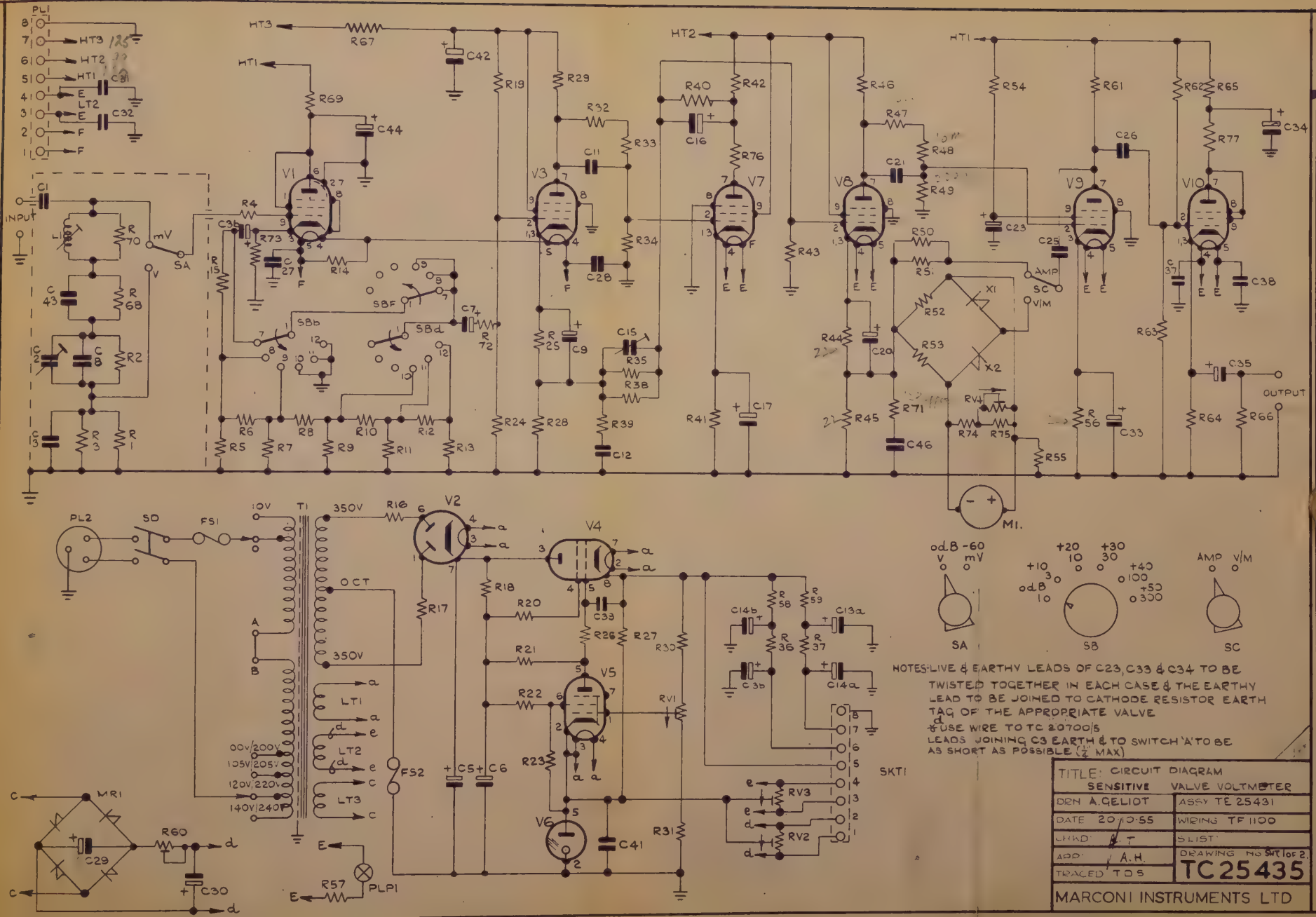
Supply Voltages

Supply	Voltage Measured	Tolerance
H.T. (a.c.)	347 - 0 - 347 (1000)	350 - 0 - 350 V ±10%
L.T.1	6.1 (10)	6.3 V ±0.3 V on valves
L.T.2	6.5 (10)	6.5 V ±0.3 V on valves
L.T.3 (a.c.)	24.5 (25)	24 V ±10%
H.T. on C5	358 (1000)	355 V ±10%
H.T. on C6	337 (1000)	340 V ±10%
H.T.1	180 (250)	Set to 180 V
H.T.2	99 (250)	100 V ±20%
H.T.3	125 (250)	125 V ±20%
H.T. on C42	99 (250)	100 V ±20%

Electrode Voltages

(Measured with respect to chassis).

Valve	Anode	Screen	Cathode
1	119 (250)	- -	1.8 (2.5)
3	90 (250)	99 (250)	3.0 (10)
4	358 (1000)	315 (1000)	180 (250)
5	174 (250)	110 (250)	80 (100)
6	80 (250)	- -	- -
7	92 (250)	99 (250)	1.9 (2.5)
8	94 (250)	99 (250)	1.95 (2.5)
9	140 (250)	132 (250)	2.6 (10)
10	88 (250)	- -	9.45 (10)



NOTES: LIVE & EARTHY LEADS OF C23, C33 & C34 TO BE TWISTED TOGETHER IN EACH CASE & THE EARTHY LEAD TO BE JOINED TO CATHODE RESISTOR EARTH TAG OF THE APPROPRIATE VALVE
& USE WIRE TO TC 20700/5
LEADS JOINING C3 EARTH & TO SWITCH 'A' TO BE AS SHORT AS POSSIBLE (½" MAX)

TITLE: CIRCUIT DIAGRAM SENSITIVE VALVE VOLTMETER	
DRN A.GELIOT	ASSY TE 25431
DATE 20/10/55	WIRING TF 1100
CHKD: T	S LIST:
APP: A.H.	DRAWING NO SHT 1 OF 2. TC25435
TRACED T D S	
MARCONI INSTRUMENTS LTD	

RESISTORS

R1	50-50KΩ S.I.C	½W	94/TF.1100	
R2	10MΩ	±5%	¾W	93/TF.1100
R3	11KΩ	±5%	¼W	87/TF.1100
R4	100Ω	±10%	½W	71/TF.1100
R5	258·5Ω	±1%	¼W	75/TF.1100
R6	560Ω	±1%	¼W	80/TF.1100
R7	378·5Ω	±1%	¼W	78/TF.1100
R8	560Ω	±1%	¼W	80/TF.1100
R9	378·5Ω	±1%	¼W	78/TF.1100
R10	560Ω	±1%	¼W	80/TF.1100
R11	378·5Ω	±1%	¼W	78/TF.1100
R12	560Ω	±1%	¼W	80/TF.1100
R13	258·5Ω	±1%	¼W	75/TF.1100
R14	62Ω	±5%	1W	72/TF.1100
R15	425Ω	±1%	¼W	79/TF.1100
R16	100Ω	±10%	½W	71/TF.1100
R17	100Ω	±10%	½W	71/TF.1100
R18	4·7KΩ	±10%	½W	83/TF.1100
R19	1·8MΩ	±5%	½W	73/TF.1100
R20	4·7KΩ	±10%	½W	83/TF.1100
R21	1MΩ	±10%	½W	92/TF.1100
R22	330KΩ	±10%	½W	91/TF.1100
R23	47KΩ	±10%	½W	89/TF.1100
R24	47KΩ	±5%	¼W	76/TF.1100
R25	220Ω	±10%	½W	74/TF.1100
R26	4·7KΩ	±10%	½W	83/TF.1100
R27	22KΩ	±10%	1W	88/TF.1100
R28	22Ω	±2%	¼W	96/TF.1100
R29	1KΩ	±2%	¼W	97/TF.1100
R30	100KΩ	±10%	½W	90/TF.1100
R31	47KΩ	±10%	½W	89/TF.1100
R32	10MΩ	±10%	½W	77/TF.1100
R33	10MΩ	±10%	½W	77/TF.1100
R34	220KΩ	±10%	½W	81/TF.1100
R35	1·5KΩ	±2%	¼W	98/TF.1100
R36	2·2KΩ	±10%	1W	82/TF.1100
R37	2·2KΩ	±10%	1W	174/TF.1100
R38	6·8KΩ	S.I.C.	½W	85/TF.1100
R39	390Ω	±10%	½W	175/TF.1100
R40	100KΩ	±10%	½W	84/TF.1100
R41	220Ω	±10%	½W	74/TF.1100
R42	1KΩ	±2%	¼W	97/TF.1100
R43	220KΩ	±10%	½W	81/TF.1100
R44	220Ω	±10%	½W	74/TF.1100
R45	22Ω	±2%	¼W	96/TF.1100
R46	1KΩ	±2%	¼W	97/TF.1100
R47	10MΩ	±10%	½W	77/TF.1100
R48	10MΩ	±10%	½W	77/TF.1100
R49	220KΩ	±10%	½W	81/TF.1100
R50	6·8KΩ	S.I.C.	½W	85/TF.1100
R51	1·5KΩ	±2%	⅛W	98/TF.1100
R52	820Ω	±10%	½W	167/TF.1100
R53	820Ω	±10%	½W	167/TF1100
R54	33KΩ	±10%	½W	148/TF.1100
R55	33KΩ	S.I.C.	½W	148/TF.1100
R56	240Ω	±10%	½W	149/TF.1100
R57	10Ω	±10%	½W	70/TF.1100
R58	2·2KΩ	±10%	1W	82/TF.1100
R59	2·2KΩ	±10%	1W	82/TF.1100
R60	50Ω ADJUSTING		10W	95/TF1100
R61	6·8KΩ	±2%	½W	144/TF.1100
R62	3·9MΩ	±10%	½W	145/TF.1100
R63	220KΩ	±10%	½W	81/TF.1100
R64	1KΩ	±10%	½W	146/TF.1100
R65	10KΩ	±10%	1W	147/TF.1100
R66	10KΩ	±10%	½W	86/TF.1100
R67	22KΩ	±10%	½W	150/TF1100
R68	4·7KΩ	±10%	½W	169/TF.1100
R69	22KΩ	±10%	½W	170/TF.1100
R70	6·8K	±10%	½W	171/TF.1100
R71	150Ω	S.I.C.	½W	172/TF1100
R72	47Ω	±10%	½W	173/TF.1100
R73	680Ω	±10%	¼W	168/TF1100
R74	1KΩ	±5% W.W.		185/TF1100
R75	2KΩ	±5% W.W.		186/TF1100
R76	47Ω	±10%	½W	192/TF1100
R77	47Ω	±10%	½W	192/TF1100

VARIABLE

RV1	50KΩ	±10%	1W	99/TF.1100
RV2	1KΩ	±10%	⅛W	100/TF.1100
RV3	1KΩ	WIREWOUND		108/TF.1100
RV4	10KΩ	±10%	1W	101/TF.1100

CAPACITORS

C1	·002μF ±20% 300V.A.C.	158/TF1100
C2	·5-3pF PRE-SET	110/TF.1100
C3	·005μF ±20% 400V.D.C.	107/TF.1100
C5	8μF ELECT 450V.D.C.	102/TF.1100
C6	32μF ELECT 450V.D.C.	103/TF.1100
C7	25μF ELECT. 12V.D.C.	104/TF.1100
C8	2·2pF ±10% 500V.D.C	109/TF.1100
C9	500μF ELECT 6V.D.C.	105/TF.1100
C11	·1μF ±20% 250V.D.C.	111/TF.1100
C12	·01μF ±20% 400V.D.C.	106/TF.1100
C13a	32-32 ELECT 275V.D.C.	112/TF.1100
C13b	32-32 ELECT 275V.D.C.	112/TR1100
C14a	32-32 ELECT 275V.D.C.	112/TF.1100
C14b	32-32 ELECT 275V.D.C.	112/TF.1100
C15	3-30pF PRESET TRIM.	156/TF.1100
C16	8μF ELECT 275V.D.C.	114/TF.1100
C17	500μF ELECT 6V.D.C.	105/TF.1100
C20	500μF ELECT 6V.D.C.	105/TF.1100
C21	·1μF ±20% 250V.D.C.	111/TF.1100
C23	4μF ELECT. 200V.D.C.	53/TF.1100
C25	2μF ±20% 150V.D.C.	154/TF1100
C26	·01μF ±20% 400V.D.C.	106/TF.1100
C27	·01μF ±20% 400V.D.C.	106/TF.1100
C28	·01μF ±20% 400V.D.C.	106/TF1100
C29	100μF ELECT. 50V.D.C.	115/TF.1100
C30	100μF ELECT 50V.D.C.	115/TF.1100
C31	·01μF ±20% 400V.D.C.	106/TF1100
C32	·01μF ±20% 400V.D.C.	106/TF.1100
C33	500μF ELECT 6V.D.C.	105/TF.1100
C34	8μF ELECT 275V.D.C.	114/TF.1100
C35	100μF ELECT 25V.D.C.	155/TF.1100
C36	100μF ELECT 6V.D.C	113/TF1100
C37	·01μF ±20% 400V.D.C	106/TF1100
C38	·01μF ±20% 400V.D.C	106/TF.1100
C39	·01μF ±20% 400V.D.C	106/TF.1100
C41	200pF ±20% 600V.D.C	152/TF.1100
C42	16μF +50%-20% 350V.D.C	157/TF.1100
C43	68pF S.I.C	176/TF.1100
C44	16μF 250VDC	177/TF.1100
C46	·001μF B.B.9 W99	179/TF.1100

VALVES

V1	EF86		119/TF.1100
V2	6X4		122/TF.1100
V3	E.180F		120/TF.1100
V4	KT66	CV1075	123/TF.1100
V5	EF95	CV850	121/TF.1100
V6	5651		124/TF.1100
V7	E.180F		120/TF.1100
V8	E180F		120/TF.1100
V9	E180F		120/TF.1100
V10	E180F		120/TF.1100

SWITCHES

SA	2 POS.	1 SECTION	46/TF.1100
SB	6 POS.	3 SECTIONS	44/TF.1100
SC	2 POS.	1 SECTION	45/TF.1100
SD	D.P.D.T.	ON-OFF	19/TF.1100

PLUGS

PL1	CHASSIS MTG PLUG 8 WAY	54/TF.1100
PL2	MAINS PLUG	1/TM.2560

CRYSTALS.

X1	CG4E	151/TF.1100
X2	CG4E	151/TF.1100

METER

M1	100μA F.S.D.		2/TF.1100

TRANSFORMER

T1	MAINS	1/TF.1100

MISCELLANEOUS

PLP1	MCC. 6V ·15A	12/TF.1100
L1	INDUCTANCE	68/TF.1100
MR1	RECTIFIER 440-SC-181-Z	67/TF.1100
SKT1	SOCKET FREE 8 WAY	55/TF.1100
FS1	FUSE 1AMP	60/TF.1100
FS2	FUSE 100mA	61/TF.1100

CIRCUIT DIAGRAM

TITLE SENSITIVE VALVE VOLTMETER

DRAWN A. GELIOT	ASSY. TF.25431
DATE 20.10.55	WIRING TF.1100
CHKD.	& LIST
APP. E.G.	DRG. No SHEET 2 OF 2 SHEETS
TRACED B.R.S.	TC25435

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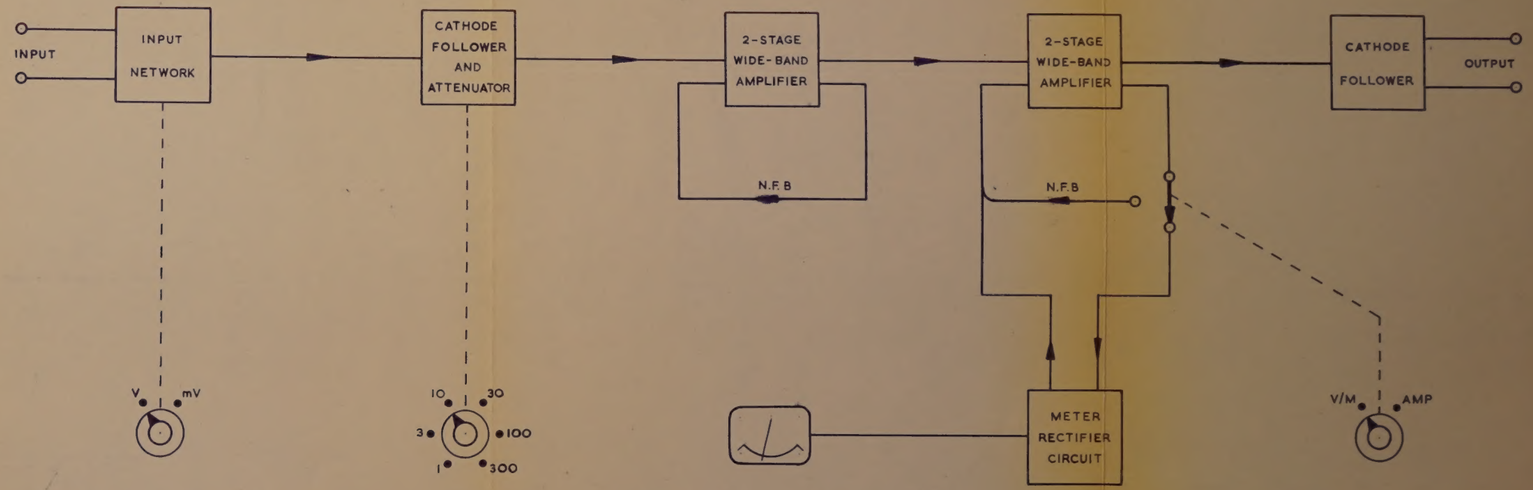

BLOCK SCHEMATIC DIAGRAM OF SENSITIVE VALVE VOLTMETER TYPE TF1100

TITLE	BLOCK SCHEMATIC DIAGRAM OF SENSITIVE VALVE VOLTMETER TYPE TF1100						
DRAWN	DATE	CHKD.	APPD.	TRCD.	ASSEMBLY	STOCK LIST	DRAWING NUMBER
A.H.R	6.60					TF1100	XD 25315
MARCONI INSTRUMENTS LTD.							SHEET 1 OF 1 SHEETS

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